

Method and Apparatus for a Gravity and Buoyancy Engine

FIELD OF THE INVENTION

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The present invention relates generally to the field of energy generation. Specifically, the present invention provides a means and method to generate useable electrical energy via a cyclical process harnessing both buoyancy and gravity at various stages of operation.

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BACKGROUND OF THE INVENTION

The energy demands of modern humans are understood to be met primarily by means that pollute or otherwise damage the environment. Energy generation via the burning of fossil fuels produces manifold hazards both in immediate environmental degradation during extraction, refinement, and consumption and in the longer-term effects that the release of large quantities of greenhouse and toxic gasses may have on the atmosphere. To an appreciable extent nuclear power has supplanted fossil fuel electricity generation and avoided some of these shortcomings. However, the potential for catastrophic failures stemming from natural disasters, improper maintenance, improper storage and handling of fissile materials, and simple operator error cannot be ignored. Modern renewable sources of power show some promise, lacking the direct harmful effects of fossil fuels and lacking the potential for extreme eventualities presented by nuclear power. However, renewable sources are not yet reliable enough to satisfy a need for a consistent baseload of power generation, lacking the promise of consistent wind, sunlight, or sufficient battery storage capacity to bridge these low-production periods.

The present invention offers a means to generate clean, consistent electrical energy, without reliance on any form of fossil fuels or nuclear power. The present invention offers a means to harness the opposing forces of gravity and buoyancy in a continuous cycle to provide grid-scale production of power in a unitized, deployable

package. The input materials ideally call for a series of Douglas fir logs, recycled plastic
pontoon, or any suitably buoyant material in the proper dimensions to fit within a
correspondingly scaled iteration of the present invention. Provided a suitable connection
to a local grid, the present invention may produce useable electricity absent any
5 additional consumable fuels, flowing water, sunlight, wind, or other limitations normally
associated with grid-scale energy production.

BRIEF DESCRIPTION OF THE DRAWINGS

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FIG. 1 is a perspective view of the present invention, wherein the present invention is
illustrated in a partially exploded configuration;

FIG. 2 is an alternate perspective view thereof, wherein the present invention is rendered
as transparent to illustrate internal construction;

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FIG. 3 is a left side elevational view thereof.

FIG. 4 is a detail view of area 4 in FIG. 3.

FIG. 5 is a detail view of area 5 in FIG. 3.

FIG. 6 is a sectional view taken along line 6-6 in FIG. 3.

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FIG. 7 is a schematic diagram of the pneumatic functions of the present invention,
wherein fluid connections are indicated in solid-line and electrical connections are
indicated in dashed-line.

FIG. 8 is a schematic diagram of the hydraulic functions of the present invention, wherein
fluid connections are indicated in solid-line and electrical connections are indicated in
dashed-line.

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DETAIL DESCRIPTIONS OF THE INVENTION

All illustrations of the drawings are for the purpose of describing selected
30 versions of the present invention and are not intended to limit the scope of the present
invention.

In reference to FIG. 1 through 8, the present invention is a gravity and buoyancy engine. The present invention offers a means to generate clean, consistent electrical energy, without reliance on any form of fossil fuels or nuclear power. The present invention offers a means to harness the opposing forces of gravity and buoyancy in a continuous cycle to provide grid-scale production of power in a unitized, deployable package. The input materials ideally call for a series of Douglas fir logs, recycled plastic pontoons, or any suitably buoyant material in the proper dimensions to fit within a correspondingly scaled iteration of the present invention. Provided a suitable connection to a local grid, the present invention may produce useable electricity absent any consumable fuels, flowing water, sunlight, wind, or other limitations normally associated with grid-scale production.

The gravity and buoyancy engine provides a means to extract useable electrical energy by a cyclical process harnessing the opposing forces of buoyancy and gravity with specific structures and processes to be described herein. The gravity and buoyancy engine comprising a gravity chamber 10, at least one airlock chamber 20, a buoyancy chamber 40, at least one electricity producing system 60, at least one buoyant object 11, and at least one vertical motion transfer assembly 50. The gravity chamber 10 defines an enclosed space with suitable clearance for the buoyant object 11 to traverse therethrough without binding to the interior of the gravity chamber 10 or any exposed components of the vertical motion transfer assembly 50 therein. The gravity chamber 10 normally traverses into the airlock chamber 20, defining an area wherein the buoyant object 11 may be transferred between an ambient pressure area to a higher-pressure area as may be required to eventually maneuver the buoyant object 11 into the buoyancy chamber 40 without compromising the integrity of the buoyancy chamber 40 or flooding the airlock chamber 20 with any volume of fluid otherwise contained within the buoyancy chamber 40. Accordingly, the buoyancy chamber 40 provides a generally vertical column of fluid of greater density than the buoyant object 11 in fluid communication with the airlock chamber 20, whereby the buoyant object 11 will be returned to a position approaching the entrance of the gravity chamber 10 to repeat the a cycle through the present invention. It is specifically contemplated that the connection from the airlock chamber 20 to the buoyancy chamber 40 may provide a vertical drop terminating in a submerged angled

facet such that the falling buoyant object **11** may more expediently traverse into the buoyancy chamber **40**, i.e. that the buoyant object will deflect off of the interior of the buoyancy chamber post-immersion and enter the fluid column contained therein. The vertical motion transfer assembly **50** ideally defines a continuous elevator system
5 enabling the unfettered onload and offload of the buoyant object **11** at the top and bottom ends of the elevator, respectively. The vertical motion transfer assembly **50** is arranged within the gravity chamber **10** to capture the force of the buoyant object **11** falling downward therethrough. More specifically, the electricity producing system **60** is linked to the vertical motion transfer assembly **50** to be provided operating power, i.e. the
10 kinetic energy of the buoyant object **11** under gravity rendered available by the vertical motion transfer assembly **50**.

The vertical motion transfer assembly **50** further comprises at least one link chain **54**, at least one first shaft **56**, a first gear **57**, at least one second shaft **58**, a second gear **59**, and a buoyant object chain ledge **55**. The link chain **54** defines a continuously
15 connected chain of suitable material quality to support the weight of at least one buoyant object **11** engaged to the vertical motion transfer assembly **50** at the buoyant object chain ledge **55**. Accordingly, the buoyant object chain ledge **55** is contemplated to protrude from the link chain **54** to provide a capture area for the buoyant object **11** at the upper end of the vertical motion transfer assembly **50** that will automatically be withdrawn at the
20 lower end as the link chain **54** recirculates within the gravity chamber **10**. The first gear **57** is connected to the first shaft **56** and the second gear **59** is connected to the second shaft **58**. Further, the link chain **54** is rotatably connected to the first gear **57** and the second gear **59**. Thusly, the first shaft **56** and the second shaft **58** provide rotating axles for the link chain **54** to recirculate about at opposing ends of the gravity chamber **10**.
25 Accordingly, the electricity producing system **60** is rotatably linked to the first shaft **56**, whereby the recirculation of the link chain **54** will rotate the first shaft **56** to provide operating power to the electricity producing system **60**. The link chain **54** is further contemplated to directly engage the first gear **57** and the second gear **59** to prevent slippage of the vertical motion transfer assembly **50** if configured to load multiple
30 instances of the buoyant object **11** simultaneously.

According to one embodiment, the present invention further comprises a transmission **63** and the electricity producing system **60** is a generator **61**. Additionally, the generator **61** comprises a generator input shaft **62**. The transmission **63** defines any mechanism as may be understood by a skilled individual to provide a means of governing the output rotational rate of a mechanism relative to an input rotational rate. In this embodiment, the transmission **63** will be operatively connected between the first shaft **56** of the vertical motion transfer assembly **50** and a generator input shaft **62**, thereby enabling an operator of the present invention to achieve and maintain an optimal rotational rate of the generator input shaft **62** for power generation irrespective of the rate of rotation of the first shaft **56**. Moderation of torsional forces may also be achieved by this means, whereby maximal torque of the first shaft **56** may be converted to maximal rotational velocity of the generator input shaft **62**.

In at least one alternate embodiment, the at least one electricity producing system **60** comprises an alternator **64** and an alternator input pulley **65**. Additionally, the vertical motion transfer assembly **50** further comprises at least one alternator belt. To enable fullest usage of this embodiment, the alternator belt is rotatably connected between the alternator input pulley **65** and a desired shaft **66** selected from the group consisting of the first shaft **56** and the second shaft **58**. The linkage of the alternator **64** to the vertical motion transfer assembly **50** in this way will enable electricity required for the initial operation of the present invention to be drawn directly from the vertical motion transfer assembly **50** for use during startup or secondary operations wherein direct power from the generator **61** may be unsuitable.

It is further considered that the vertical motion transfer assembly **50** further comprises at least one accessory belt drive **12**. The accessory belt drive **12** defines a secondary driven linkage between the vertical motion transfer assembly **50** and any installations or portions of the present invention that may extract useable power from the operation of the vertical motion transfer assembly **50**. Accordingly, the present invention further comprises a pressure control system **39**, and a pump input shaft **13**. The pressure control system **39** in this embodiment provides a means for generating and vectoring an atmospheric pressure differential as is understood to be required for the operation of the airlock chamber **20** and the buoyancy chamber **40** in various stages of the functionality of

the present invention. In a general interpretation, the pressure control system **39** is understood to be operatively connected with all components described herein as may be required to fully operate the present invention by the methods described, including continuous adjustment of the recirculation rate of multiple instances of the buoyant object **11** through the present invention to maximize efficacy of all interrelated processes described herein. More specifically, the accessory belt drive **12** comprises at least one first sheave **14**, at least one second sheave **15**, and at least one accessory belt **16**. The first sheave **14** and the second sheave **15** collectively provide a means of mounting the accessory belt **16** to the vertical motion transfer assembly **50**, ideally individually defining a channeled disk fixed to rotating elements of said vertical motion transfer assembly **50**. Accordingly, the first sheave **14** is mounted to the first shaft **56**, opposite the first gear **57** across the first shaft **56** and the second sheave **15** is mounted to the second shaft **58**, opposite the second gear **59** across the second shaft **58**. The accessory belt **16** is connected between the first sheave **14** and the second sheave **15** to provide a means of synchronizing the rotational velocity of both respective components while simultaneously enabling the transfer of rotational energy to the pump input shaft **13**. In this configuration, the pump input shaft **13** is rotatably connected between the accessory belt **16** and the pressure control system **39**, thereby providing operating power to the pressure control system **39**.

In one functional embodiment, the at least one vertical motion transfer assembly **50** is a plurality of vertical motion transfer assemblies **51**, wherein the plurality of vertical motion transfer assemblies **51** are distributed across the gravity chamber **10** such that the buoyant object **11** may be suspended between the buoyant object chain ledge **55** of an arbitrary transfer assembly **52** and the buoyant object chain ledge **55** of an adjacent transfer assembly **53**, wherein the arbitrary transfer assembly **52** and the adjacent transfer assembly **53** are from the plurality of vertical motion transfer assemblies **51**. This configuration may be superior to a single vertical motion transfer assembly **50** due to the contrarotating plurality of vertical motion transfer assemblies **51** as the buoyant object chain ledge **55** progresses tangent to the first gear **57** and second gear **59**, respectively. More specifically, the buoyant object chain ledge **55** of the arbitrary transfer assembly **52** and the adjacent transfer assembly **53** are brought together at the upper end of the gravity

chamber **10** to effectively engage the buoyant object **11** and subsequently separated at the lower end of the gravity chamber **10** to disengage or eject the buoyant object **11** from the gravity chamber **10**.

The present invention may additionally comprise a plurality of tensioner pulley assemblies **17**, wherein each of the plurality of tensioner pulley assemblies **17** is rotatably connected in between a corresponding arbitrary transfer assembly **18** and a corresponding adjacent transfer assembly **19**, wherein the corresponding arbitrary transfer assembly **18** and the corresponding adjacent transfer assembly **19** are from the plurality of vertical motion transfer assemblies **51**. The plurality of tensioner pulley assemblies **17** defines a series of fixed or adjustable pivots about which the ductile components of the present invention may be drawn to ensure appropriate operating tension along said components to enable effective purchase on any driving and driven components of such mobile assemblies. More specifically, the plurality of tensioner pulley assemblies **19** ensures that the corresponding arbitrary transfer assembly **18** and the corresponding adjacent transfer assembly **19** are rotationally bound to one another to prevent over- or under-rotation of either element. This configuration may forestall any mismatch or misalignment or any supported or interconnected components, i.e. the buoyant object **11** or the electricity producing system **60**.

Relevant to the displacement of the buoyant object **11** between the gravity chamber **10** and the buoyancy chamber **40**, the airlock chamber **20** further comprises a transfer channel **21**, at least one pressurized chamber **34**, the pressure control system **39**, at least one valve **22**, and a plurality of airlock doors **23**. The transfer channel **21** provides a passage for the buoyant object **11** to traverse the pressurized chamber **34** into the buoyancy chamber **40**, including various operable components intended to meter the govern the progress of said buoyant object **11** therethrough. The pressurized chamber **34** defines a zone in fluid communication with the pressure control system **39** through the valve **22** wherein local atmospheric pressure may be controllably incremented and decremented to maintain the integrity of the buoyancy chamber **40** during operation of the present invention, said increments and decrements to be handled by the pressure control system **39** as previously outlined. Accordingly, the plurality of airlock doors **23** is configured to sequentially open and close to maintain the integrity of the pressurized

zone therein, including containing the buoyant object **11** during various stages of operation. More specifically, the pressurized chamber **34** is delineated by a first door **24** and a second door **25**, wherein the first door **24** and the second door **25** are from the plurality of airlock doors **23**. In at least one functional embodiment the sequential
5 arrangement of the first door **24** and the second door **25** may be repeated indefinitely to create additional instances of the pressurized chamber **34** to enable a more gradual transition between local ambient pressure and an equivalent pressure to the lower end of the buoyancy chamber **40**.

The plurality of airlock doors **23** may further comprise a panel **26** and an
10 inflatable seal **27**. The panel **26** defines a structure that may substantially occlude the transfer channel **21** when configured to a closed position. The inflatable seal **27** provides an expandable gasket mounted perimetrically around the panel **26** in fluid communication with the pressure control system **39**. In this configuration each of the plurality of doors are hingedly connected to a lateral sidewall of the transfer channel **38**, with specific
15 consideration given to a hinge construction that does not impede the expansion of the inflatable seal **27** match the internal dimensions of the transfer channel **21**. During an opening cycle of an airlock door the inflatable seal **27** may be deflated to allow the pressurized chamber **34** and the local atmosphere to equalize before the panel **26** is swung to an open position. In reverse, the panel **26** may be swung to a closed position
20 and the inflatable seal **27** may be expanded to fully enclose the pressurized zone.

In some embodiments, the pressure control system **39** may further comprise at least one hydraulic pump **67**, at least one pneumatic pump **68**, at least one pressurized tank **69**, a plurality of airlock regulators **70**, and a plurality of buoyancy regulators **71**. The hydraulic pump **67** and the pneumatic pump **68** are both independently operatively
25 coupled to the vertical motion transfer assembly **50**, wherein the vertical motion transfer assembly **50** provides the operating power for both components. The independent and redundant construction of these components enables the compartmentalization of malfunctions and maintenance to ensure that operation of the present invention is not affected by periodic non-functionality of any of these essential elements. More
30 specifically, the hydraulic pump **67** is in fluid communication with the buoyancy chamber **40** to enable the cyclical movement of fluid during various stages of operation.

Similarly, the pneumatic pump **68** is in fluid communication with the pressurized tank **69** to enable the storage of high-pressure atmosphere for use within the present invention. Accordingly, the pressurized tank **69** is in fluid communication with the airlock chamber **20** through the plurality of airlock regulators **70** and the buoyancy chamber **40** through the plurality of buoyancy regulators **71**, whereby the application of pressurized air may be employed to specific effect as required by adjustable operating standards.

To further improve the sequential flow of the buoyant object **11** through the transfer channel **21**, the airlock chamber **20** may further comprise at least one bollard-receiving receptacle **28**, at least one chamber bollard, and at least one chamber hatch **30**.

The bollard-receiving receptacle **28** defines a hollow cutout normally traversing into the lateral sidewall of the transfer channel **38** to enable the chamber bollard **29** to be shifted from a position impeding the passage of a buoyant object **11** to a position enclosed within the bollard-receiving receptacle **28** and the chamber hatch **30**. Accordingly, the chamber bollard **29** defines a deployable blocking structure slidably mounted within the bollard-receiving receptacle **28**, ideally extended and retracted via pressurized air. The principal effect of the chamber bollard **29** is to prevent the buoyant object **11** from partially entering the pressurized chamber **34** such that the first door **24** may jam against said buoyant object **11** while attempting to close. To prevent this malfunction, the bollard-receiving receptacle **28** is positioned offset from the first door **24** along the transfer channel **21** to interrupt the movement of the buoyant object **11** either within the pressurized chamber **34** or prior to entering the pressurized chamber **34**. The chamber hatch **30** is hingedly mounted to the lateral sidewall of the transfer channel **38** such that the chamber hatch **30** is positioned over the bollard-receiving receptacle **28** when closed. This configuration will enable the chamber hatch **30** to act as a bridge over the otherwise exposed bollard-receiving receptacle **28**, thereby preventing the buoyant object **11** from binding in the open cavity. In an instance that the chamber bollard **29** is extended the chamber hatch **30** will be deflected aside to permit the protrusion of the chamber bollard **29**. In the ideal embodiment of the present invention, the present invention will comprise a first plurality of bollards **32** and a second plurality of bollards **33** slidably mounted onto the lateral sidewall of the transfer channel **38**. Further, the at least one pressurized chamber **34** is a plurality of pressurized chambers **35** wherein the plurality of pressurized

chambers **35** is serially distributed along the transfer channel **21**. Each of the first plurality of bollards **32** is positioned offset from the first door **24** of a corresponding chamber **36**, wherein the corresponding chamber **36** is from the plurality of pressurized chambers **35**. Each of the second plurality of bollards **33** is subsequently positioned
5 opposite to the second door **25**, across the first door **24** of the corresponding chamber **36**. Additionally, each of the second plurality of bollards **33** is positioned in between the first door **24** and the second door **25** of the corresponding chamber **36**. This configuration will enable an operator of the present invention to arrest the movement of the buoyant object **11** prior to entering the corresponding chamber **36** to limit the flow of successive
10 instances of the buoyant object **11** and prevent the airlock chamber **20** from becoming jammed. More succinctly, an instance of the chamber bollard **29**, bollard-receiving receptacle, and chamber hatch **30** will be positioned ahead of each instance of the first door **24** throughout the transfer channel **21** to enable the effective management of sequential instances of the buoyant object **11** traversing the airlock chamber **20**.

15 In another embodiment of the present invention, the airlock chamber **20** may comprise a plurality of transfer guides **31** mounted onto the lateral sidewall of the transfer channel **38**. The plurality of transfer guides **31** individually defines actuated paddles or bumpers that serve to center the buoyant object **11** in the transfer channel **21** to prevent jams due to the orientation of the buoyant object **11** becoming crooked relative to said
20 transfer channel **21**. Similar to the chamber bollard **29**, the plurality of transfer guides **31** is ideally extended and retracted by pressurized air provided via the pressure control system **39** as outlined above. To enable the effective manipulation of the buoyant object **11** as described, the plurality of transfer guides **31** is distributed along the transfer channel **21** and configured to protrude into the pressurized chamber **34**. To avoid
25 interference with the plurality of airlock doors **23**, the plurality of transfer guides is positioned offset from the plurality of airlock doors **23** along the transfer channel **21**.

The buoyancy chamber **40** further comprises a buoyancy channel **41**, a staging door **42**, a drainage platform **43**, a reservoir **44**, an inlet **45**, and an outlet **46**. The buoyancy channel **41**, similar to the transfer channel **21**, provides a passage for the
30 buoyant object **11** to continue circulation through the present invention. The buoyancy channel **41** is necessarily filled with a fluid of greater density than the buoyant object **11**,

thereby enabling the buoyant object **11** to rise through the buoyancy channel **41**. The staging door **42** defines a similar component to any one of the plurality of airlock doors **23**, wherein the staging door **42** may be operatively closed and opened to maintain the integrity of the buoyancy chamber **40** or release a buoyant object **11**, respectively. The staging door **42** is specifically contemplated to be hingedly mounted between the buoyancy channel and the gravity chamber **10**, with the drainage platform **43** being positioned withing the buoyancy channel opposite the gravity chamber **10** across the staging door. The drainage platform **43** provides a means of reducing the volume of fluid in the buoyancy channel **41** adjacent to the staging door **42** to permit the ejection of said buoyant object **11** without reducing the overall fluid in circulation through the buoyancy channel **41**. The reservoir **44** is in fluid communication with the drainage platform **43**, thereby providing an area separate from the buoyancy chamber **40** to retain any displaced fluid in an instance where the staging door **42** is opened. To enable the reintroduction of fluid to the buoyancy channel **41**, the inlet **45** is integrated into the reservoir **44** and the outlet **46** is integrated into the buoyancy chamber **40**, the outlet **46** is positioned offset from the drainage platform **43**, across the buoyancy channel **41**. In this configuration, the reservoir **44** is in fluid communication with the buoyancy channel **41** through the inlet **45** and the outlet **46** to enable the operation of the staging door **42** as described, i.e. to enable the controlled drainage or replenishment of the fluid in the buoyancy channel **41** to permit the buoyant object **11** to be cycled into and out of the buoyancy chamber **40**.

The buoyancy chamber **40** may further comprise a plurality of staging guides **47**. The plurality of staging guides **47** defines a series of operable manipulators similar in form and function to the plurality of transfer guides **31** described previously. In this embodiment the plurality of staging guides is mounted onto a lateral sidewall of the buoyancy channel **48**, protruding into the buoyancy channel **41**. To enable the continuous alignment of the buoyant object **11** within the buoyancy channel **41** the plurality of staging guides **47** is further distributed along the buoyancy channel **41**. Also similar to the plurality of transfer guides **31**, the plurality of staging guides **47** is positioned offset from the staging door **42** along the buoyancy channel **41** to prevent the any interference between the simultaneous operation of the plurality of staging guides **47** and the staging door **42**. As outlined above the pressure system ideally provides the operating power to

the plurality of staging guides **47** and the staging door **42** in a similar fashion to the plurality of transfer guides **31** and the plurality of airlock doors **23**, i.e. introducing controlled volumes of high-pressure air to each component in sequence to enable the continuous operation of the present invention.

- 5 To elaborate on the cyclical process related to the operation of the present invention, the buoyant object **11** may begin in a position and configuration to enter the gravity chamber **10** and vertical motion transfer assembly **50** via gravity after passing through the buoyancy chamber **40**, wherein the buoyancy chamber **40** has released the buoyant object **11** at an elevated position relative to the upper end of the vertical motion
- 10 transfer assembly **50**. The buoyant object **11** will ideally engage the vertical motion transfer assembly **50** as the buoyant object chain ledge **55** is cycled into position to receive said buoyant object **11**. In response to the buoyant object **11** engaging the vertical motion transfer assembly **50**, the buoyant object **11** traverses downward through the gravity chamber **10** toward the airlock chamber **50**, thereby providing motive force to the
- 15 vertical motion transfer assembly **50**. It is further contemplated that the entrance of the gravity chamber **10** may be blocked a gravity door, wherein the gravity door may be operably coupled to a plurality of switches linearly dispersed along the gravity chamber **10**. In this configuration, the timing of the present invention may be affected by an instance of the buoyant object **11** engaged to the vertical motion transfer assembly **50**
- 20 sequentially contacting the plurality of switches. The arrangement and effect of the individual entities defined within the plurality of switches are understood to be variable in multiple configurations of the present invention, but at least one configuration will trigger the gravity door to permit an instance of the buoyant object **11** to enter the gravity chamber **10** and engage the vertical motion transfer assembly **50** as described.
- 25 Corresponding to the movement of the vertical motion transfer assembly **50** caused by the buoyant object **11** moving toward the airlock chamber **50**, the vertical motion transfer assembly **50** may further provide operating power to the electricity producing system **60**. Subsequently, the buoyant object **11** is configured to enter the air lock chamber via gravity after passing through the gravity chamber **10** and disengaging the vertical motion
- 30 transfer assembly **50**, said disengagement understood to be an inverse process of the engagement occurring as a result of the cyclical movement of the vertical motion transfer

assembly **50**. Upon entry into the airlock chamber **50** the buoyant object **11** rolls along the air lock chamber via gravity to open an airlock door **37**, wherein said airlock door **37** is biased to a closed position after the passage of said buoyant object **11** therethrough. The buoyant object **11** is subsequently cycled through repeated iterations of the airlock
5 chamber **50** to incrementally increase the ambient pressure until the buoyant object **11** may be introduced to the buoyancy chamber **40** via gravity. After entering the buoyancy chamber **40**, the buoyant object **11** will ascend the column of fluid in the buoyancy chamber **40** to return to a suitable position to reengage the vertical motion transfer assembly **50** and repeat the cyclical process as described.

10 Although the invention has been explained in relation to its preferred embodiment, it is to be understood that many other possible modifications and variations can be made without departing from the spirit and scope of the invention as hereinafter claimed.